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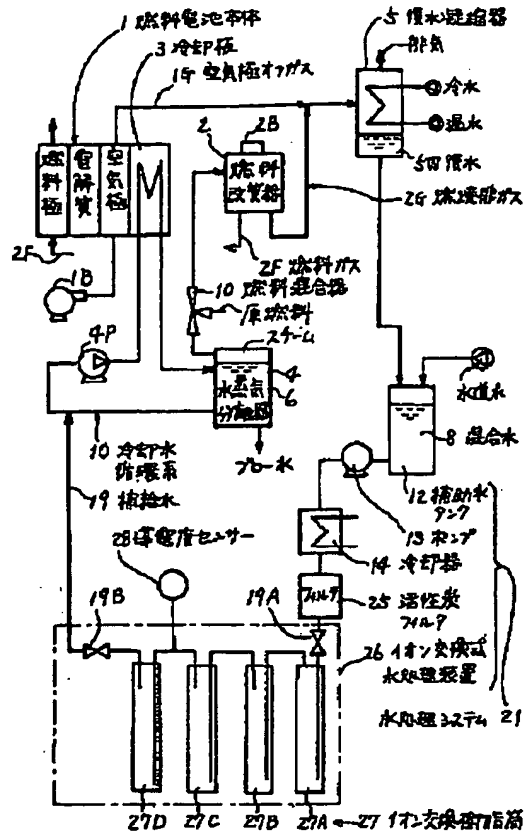

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TITLE : OPERATION METHOD FOR ION EXCHANGE WATER TREATMENT DEVICE FOR FUEL BATTERY

ABSTRACT : PROBLEM TO BE SOLVED: To provide an operation method for an ion exchange water treatment device for a fuel cell by which supply water can be maintained at low electric conductivity, and simultaneously silica concentration can be also maintained at low concentration.

SOLUTION: Service water is added to condensation 5W condensed and obtained by a condensation condenser 5 so as to form mixed water 8 which is stored in an auxiliary water tank 12, the mixed water 8 is ion exchange treated so as to form supply water 19 having low electric conductivity, and the water 19 is supplied to the cooling water circulation unit 10 of a fuel cell. Ion exchange treatment is conducted by ion exchange resin cylinders 27 which is plurally divided and arranged in series mutually, the electric conductivity of the treated water is observed on the entrance side of a last stage ion exchange resin cylinder 270 by a conductivity sensor 28. When the electric conductivity exceeds a predetermined fixed level, it is judged that the silica concentration in the treated water flowing in the last stage ion exchange resin cylinder 27D becomes high, plural ion exchange resin cylinders 27A, 27B, 27C positioning on the upstream side of the last ion exchange resin cylinder 27D are renewed.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Field of the Invention] This invention carries out ion exchange treatment of the condensation and tap water containing impurity ion, and relates to the employment approach of the ion-exchange type water treatment equipment for fuel cells supplied to the cooling water circulatory system of a fuel cell as make up water of low electrical conductivity, and the employment approach for preventing lifting of the silica concentration in make up water especially.
[Description of the Prior Art] In order to carry out long duration operation of the fuel cell with a well head, cooling generation of heat accompanying a cell reaction, and holding the temperature distribution in the layered product (it being called a stack) of a unit cell as much as possible at homogeneity to a predetermined operating temperature (it being 190-degreeC with a phosphoric acid form fuel cell before or after) is called for. Then, the fuel cell of the water cooling type which a stack makes two or more unit cells 1 block, carries out the laminating of the cooling plate between blocks, carries out conduction of the cooling water as a cooling medium to the cooling pipe laid under this cooling plate, and is cooled is known. Moreover, in order to prevent the liquid junction by cooling water arising between the cooling plates in potential which is different in a water cooled fuel cell, that in which cooling water formed the water treatment system which supplies ion exchange water to the circulatory system of cooling water since the thing with the electrical conductivity low (electric resistance is high) as much as possible was called for is known. Drawing 4 is the block diagram showing the conventional water treatment system of a water cooled fuel cell. In drawing, a generation of electrical energy is performed based on the electrochemical reaction in which hydrogen and oxygen carry out a direct reaction by inter-electrode [of a couple] by supplying fuel gas 2F to the fuel electrode of the body 1 of a fuel cell (stack) which consists of a layered product of a unit cell from the fuel refining machine 2, and supplying reaction air to an air pole from blower 1B. Moreover, the laminating of the cooling plate 3 is carried out to the body 1 of a fuel cell for every two or more unit cells, and two or more cooling pipes laid under the cooling plate 3 are connected with the cooling water circulatory system 10 containing circulating-pump 4P and the steam separator 4 which were allotted outside through the insulating coupling. By the steam separator's 4 involving low cooling water 6 whenever [place constant temperature] to the operating temperature of a fuel cell, and circulating through cooling water 6 to a cooling plate 3 by circulating-pump 4P, exhaust heat of generation-of-electrical-energy heat of formation is performed, and the temperature of the body 1 of a fuel cell is held at the operating temperature. Moreover, since a lot of generation-of-electrical-energy generation water or combustion generation water is contained in air off-gas 1G discharged from an air pole, and combustion-gas 2G which were produced by burning the residual hydrogen in fuel off-gas 1F by the burner of the fuel refining machine 2 The moisture contained in air off-gas 1G and combustion-gas 2G as a steam is cooled with the condensation condenser 5, and it collects as condensation 5W, and it is constituted so that a water treatment system 11 may be supplied. By the way, when the electrical conductivity of cooling water 6 is high, the liquid junction phenomenon in which a short-circuit current flows between cooling plates through the cooling water in the insulating coupling which connects said cooling pipe mutually will occur, and a part of generated output will be consumed vainly. Then, in order to hold the electrical conductivity of cooling water 6 below to 1microS/cm (usually 0.1-0.2microS/cm extent), a water treatment system 11 is connected with the cooling water circulatory system 10. That is, a water treatment system 11 is constituted so that the electrical conductivity of cooling water 6 may be held below to 1microS/cm in addition to the cooling water 6 within the cooling water circulatory system 10, considering as the mixed water 8 which led the condensation 7 collected with the condensation condenser 5 to the auxiliary water tank 12, and added tap water moderately, and using the ion exchange water of delivery and the obtained low electrical-and-electric-equipment electric conductivity as make up water 9 for mixed water 8 through a pump 13 and a condensator 14 at ion-exchange type water treatment equipment 16. In addition, the amount of supply of make up water 9 is controlled corresponding to the amount which supplies the insufficiency produced in case the steam in a steam separator 4 is added to a original fuel as refining reaction water through fuel

mixer (ejector) 10A and the fuel refining machine 2 is supplied, or the insufficiency produced by emitting outside by using cooling water 6 as blow water. As shown in drawing as ion-exchange type water treatment equipment 16, the ion-exchange-resin cylinders 17A, 17B, and 17C by which the rate was carried out between stop valve 19A of a couple and 19B for two or more minutes are equipped with 17, and it usually fills up with cation exchange resin and anion exchange resin as a mixed floor in each ion-exchange-resin cylinder. Moreover, 18, such as the electrical conductivity sensors 18A, 18B, and 18C, is connected to the ion-exchange-water discharge side of each ion-exchange-resin cylinder. About each ion-exchange-resin cylinder which has the property in which ion-exchange capacity declines one by one from the ion-exchange-resin cylinder of the upstream Supervise lowering of the electrical conductivity of the ion exchange water by the electric conductivity sensor, and the resin life of last stage ion-exchange-resin cylinder 17C is experientially predicted from the operation time corresponding to the resin life of 1st step ion-exchange-resin cylinder 17A, and the resin life of 2nd step ion-exchange-resin cylinder 17B. Before the life of last stage ion-exchange-resin cylinder 17C is exhausted, by performing resin exchange of the ion-exchange-resin cylinder of each stage, what was constituted so that make up water 9 of the electrical conductivity which exceeds cm in 1microS /might not be accidentally supplied to the cooling water circulatory system 10 is known. Drawing 5 is system configuration drawing showing the conventional example from which the ion-exchange type water treatment equipment for fuel cells differs. Ion-exchange type water treatment equipment 30 The main ion-exchange-resin cylinder 32 arranged on the entrance-side stop valve 19A side of mixed water 8, The auxiliary ion-exchange-resin cylinder 33 of the small capacity which is connected with a serial in the latter part, and carries out the regurgitation of make up water 9 of low electrical conductivity, It consists of electric conductivity sensors 38 connected to the upstream of this auxiliary ion-exchange-resin cylinder. It is constituted so that make up water 9 managed by the low electrical conductivity below 1microS/cm may be supplied to the cooling water circulatory system 10 of the body 1 of a fuel cell which is not illustrated through stop valve 19B of an outlet side by the electric conductivity sensor 38 (refer to publication-number 5-No. 315002 official report). In the case of this conventional example, it fills up with the amount which can breathe out make up water 9 of the low electrical conductivity in the exchange period to which the ion exchange resin 39 with which the main ion-exchange-resin cylinder 32 continues the ion exchange treatment of mixed water 8, performs it during operation of ion-exchange type water treatment equipment, and it fills up becomes settled beforehand (for example, below 1microS/cm). Moreover, the auxiliary ion-exchange-resin cylinder 33 takes charge of the ion exchange treatment of period mixed water 8 until exchange of ion exchange resin is completed temporarily from the event of the electric conductivity sensor 38 detecting that the main ion-exchange-resin cylinder 32 reached the life, and the fill of ion exchange resin is limited to the amount in which the main ion-exchange-resin cylinder 32 can breathe out make up water 9 of 1microS [/cm / less than] low electrical conductivity between the waiting for exchange. Therefore, bypass piping which is not illustrated to ion-exchange type water treatment equipment is prepared, during exchange of the ion exchange resin of the main ion-exchange-resin cylinder 32, if ion-exchange type water treatment equipment 16 is employed so that the auxiliary ion-exchange-resin cylinder 33 may take charge of ion exchange treatment, also during exchange of the main ion-exchange-resin cylinder 32, make up water 9 of low electrical conductivity can be continued, and the cooling water circulatory system 10 can be supplied.

[Problem(s) to be Solved by the Invention] Although the electric electric conductivity of the water purified by the above-mentioned ion-exchange-resin cylinder is usually held at the low electrical conductivity of 0.1-0.2microS/cm extent, there is a property rapidly deteriorating in the telophase of a life of ion exchange resin. then -- as the employment approach of conventional ion-exchange type water treatment equipment -- the control value of electrical conductivity -- 1microS/cm -- setting -- aggravation of electrical conductivity -- an early stage -- detecting -- ion exchange resin -- repacking -- etc. -- the maintenance service is performed. namely, in the ion-exchange type water treatment equipment 16 constituted like drawing 4 Since the residual life of ion-exchange-resin cylinder 17C of the last stage can be predicted at an early stage and it becomes possible to arrange exchange of ion exchange resin a little early By working by ion exchange resin repacking by the event of conductivity

sensor 18C allotted to the discharge side of ion-exchange-resin cylinder 17C of the last stage going up to 1microS/cm While the inconvenience that make up water 9 with high electrical conductivity is supplied to the ******** system 10 can avoid certainly, the remainder of the ion-exchange capacity of ion exchange resin is controlled by the minimum. Moreover, in the ion-exchange type water treatment equipment 30 shown in drawing 5 , after an electric conductivity sensor directs lowering of electrical conductivity, while a period until it ends resin exchange of the main ion-exchange-resin cylinder, and an auxiliary ion-exchange-resin cylinder carry out the regurgitation of make up water of low electrical conductivity continuously, the advantage that the ion-exchange capacity of the ion exchange resin in an auxiliary ion-exchange-resin cylinder is consumed without futility is acquired. Although it can adsorb when there is selectivity in the ion-exchange capacity of ion exchange resin, for example, the silica (it is also called Si O2 and a silicic acid) of the shape of ion with the lowest selectivity, on the other hand, also uses strong base nature ion exchange resin, to the telophase of a life when the total ion exchange capacity of ion exchange resin approaches a limitation, preferential adsorption of other anions with high selectivity is carried out, and the phenomenon in which the silica of the shape of once adsorbed ion leaks out occurs at it. Moreover, if make up water 9 containing an ion-like silica is supplied to the cooling water circulatory system 10, since it adheres to the internal surface of passage, it deposits gradually and **** etc. is blockaded at last, the problem of having an adverse effect on the cooling engine performance of the body 1 of a fuel cell occurs. However, since an ion-like silica has very weak acidity, it has the problem that break-through silica concentration is undetectable, by the electric conductivity sensor. While the technical problem of this invention can hold make up water to low electrical conductivity, it is to offer the employment approach of the ion-exchange type water treatment equipment for fuel cells that silica concentration can also be held to low concentration.
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, invention according to claim 1 It stores in an auxiliary water tank as mixed water which added tap water to the condensation which condenses the steam in the air off-gas of a fuel cell, and the combustion gas of a fuel refining machine with a condensation condenser, and is obtained. It is the employment approach of the ion-exchange type water treatment equipment which carries out ion exchange treatment of this mixed water, uses as make up water of low electrical conductivity, and is supplied to the cooling water circulatory system of said fuel cell. When the fixed level on which said ion-exchange type water treatment equipment is divided into two or more ion-exchange-resin cylinders, serial arrangement is carried out mutually, the electrical conductivity of the water under ion exchange treatment is supervised by the entrance side of the last stage ion-exchange-resin cylinder, and electrical conductivity becomes settled beforehand is exceeded, It is judged as that to which the silica concentration in the treated water which flows into said last stage ion-exchange-resin cylinder rose, and suppose that two or more ion-exchange-resin cylinders located in the upstream of said last stage ion-exchange-resin cylinder are updated. Moreover, in the employment approach of the ion-exchange type water treatment equipment for fuel cells according to claim 1, when invention according to claim 2 is constituted so that relocation which changes the last stage ion-exchange-resin cylinder of the renewal of un-of one of the updated ion-exchange-resin cylinders in the last stage to the upstream, and changes a location mutually may be performed, it is good facilities. In invention according to claim 1, a rate is carried out for two or more minutes, and the ion-exchange-resin cylinder by which serial arrangement was carried out Since ion-exchange capacity reaches a limitation one by one from the ion-exchange-resin cylinder of the entrance side of mixed water By supervising electrical conductivity by the entrance side of the last stage ion-exchange-resin cylinder By the limitation of the ion-exchange capacity to the preceding paragraph of the last stage ion-exchange-resin cylinder being detectable, and updating an ion-exchange-resin cylinder, when it goes abruptly up on the fixed level on which electrical conductivity becomes settled beforehand The ion-exchange capacity of two or more ion-exchange-resin cylinders which remove the last stage ion-exchange-resin cylinder is consumed without futility. Moreover, the break-through ion-like silica by which it is checked based on the experiment that a silica leak goes abruptly up in advance of lifting of electric electric conductivity in the telophase of the ion-exchange capacity in ion exchange resin, and it flowed into the last stage ion-exchange-resin cylinder is caught within the last stage ion-exchange-resin

cylinder by which ion exchange capacity remains enough, and make up water of low electrical conductivity and low silica concentration is supplied to the cooling water circulatory system. Moreover, in invention according to claim 2, the ion exchange capacity of the remainder of the last stage ion-exchange-resin cylinder is consumed without futility by performing relocation which changes the last stage ion-exchange-resin cylinder of the renewal of un-of one of the updated ion-exchange-resin cylinders in the last stage to the upstream, and changes a location mutually.

[Embodiment of the Invention] This invention is explained based on an example below. In addition, since the member which attached the same reference mark as the conventional example has the same function as it of the conventional example, the explanation is omitted. Drawing 1 is the block diagram of the water treatment system in which one example of invention according to claim 1 is shown. In drawing, a water treatment system 21 is constituted so that it may consider as the mixed water 8 which led the condensation 7 collected with the condensation condenser 5 to the auxiliary water tank 12, and added tap water moderately and the cooling water circulatory system 10 may be supplied at ion-exchange type water treatment equipment 26 through the charcoal filter 25 in which mixed water 8 is formed a pump 13 a condensator 14, and if needed by using the ion exchange water of delivery and the obtained low electrical-and-electric-equipment electric conductivity as make up water 9. As ion-exchange type water treatment equipment 26 is shown in drawing, it has stop valve 19A of a couple, the ion-exchange-resin cylinders 27A, 27B, and 27C by which the rate (it quadrisects by a diagram) was carried out among 19B for two or more minutes, and last stage ion-exchange-resin cylinder 27D, and usually fills up with cation exchange resin and strongly basic anion exchange resin as a mixed floor of a fixed rate in each ion-exchange-resin cylinder. Moreover, the conductivity sensor 28 is connected to upstream piping of last stage ion-exchange-resin cylinder 27D, the ion-exchange capacity to fall in order of the ion-exchange-resin cylinders 27A, 27B, and 27C of the upstream is supervised by the conductivity sensor 28, and when the electrical conductivity rises [cm] in 1microS /, renewal of the ion-exchange-resin cylinders 27A, 27B, and 27C is performed. Drawing 2 is the property diagram showing the relation between the electric conductivity of ion exchange water and silica concentration which were obtained by the ion-exchange-resin independent trial, and addition quantity of water to be treated. The electric conductivity at the time of carrying out conduction of the tap water of silica concentration 46 mg/l, and electrical conductivity S/cm of 220micro to the ion-exchange-resin cylinder which mixed cation exchange resin and strongly basic anion exchange resin at a rate of 1:1.5, The silica concentration measured with the colorimetric method is shown, and it examined by preparing the charcoal filter which has a filter with a filtration precision of 5 micrometers in the upstream of an ion-exchange-resin cylinder. In drawing, although 0.1microS/cm and silica concentration show 0.1 or less mg/l in the electrical conductivity of ion exchange water At the same time a sudden rise of electrical conductivity is accepted, when addition quantity of water to be treated arrives at the limitation of the ion-exchange capacity of ion exchange resin It turns out that silica concentration is also going abruptly up, and lifting of the silica concentration in ion exchange water and lifting of electrical conductivity follow mutually, and occur. Although lifting of silica concentration was directly supervised by time-consuming approaches, such as a colorimetric method, and it dropped off, it became clear by supervising lifting of electrical conductivity that a break through of an ion-like silica could be guessed in sufficient precision practical. In the ion-exchange type water treatment equipment 26 shown in drawing 1 from an above-mentioned test result If the ion-exchange-resin cylinders 27A, 27B, and 27C are updated when the conductivity sensor 28 goes up even for example, to 1microS/cm While being able to consume the ion-exchange capacity of the ion-exchange-resin cylinders 27A, 27B, and 27C without futility to near [the] the threshold value The weak acidic ionicity silica and the weak acidic conductive ion which it is at the updating event and were leaked from ion-exchange-resin cylinder 27C are caught by last stage ion-exchange-resin cylinder 27D. Failures, such as power loss by the liquid junction of the body 1 of a fuel cell which could supply the cooling water circulatory system 10 of the body 1 of a fuel cell by having used the ion exchange water of low electrical conductivity and low silica concentration as make up water 9, therefore became a problem with the conventional technique, and lock out of the passage by deposition of a silica, are eliminated. Drawing 3 is the block diagram of an important section showing

one example of invention according to claim 2, and in case the ion-exchange-resin cylinders 27A, 27B, and 27C are updated in the ion-exchange-resin cylinders 27E, 27F, and 27G, ion-exchange-resin cylinder (last stage ion-exchange-resin cylinder) 27D of renewal of un-is moved to the preceding paragraph, and it differs from the above-mentioned example in that relocation which arranges 1 ** 27G of the updated ion-exchange-resin cylinder as a last stage ion-exchange-resin cylinder was performed. At the renewal event of an ion-exchange-resin cylinder, last stage ion-exchange-resin cylinder 27D adsorbs the break-through ion from ion-exchange-resin cylinder 27C of the preceding paragraph, is a request and is in the condition that the great portion of ion-exchange capacity remained. Therefore, the advantage which can consume the ion-exchange capacity which remained without futility is acquired by rearranging like this example. In addition, parallel connection of the ion-exchange-resin cylinder for updating which ion exchange resin repacked beforehand or regenerated as the updating approach of an ion-exchange-resin cylinder is carried out to each ion-exchange-resin cylinder in use using piping for a switch, and it is desirable to perform updating and relocation by switch of a valve for a short time. Moreover, it prepares in order to remove beforehand a particle-like silica, a polymerization silicic acid, etc. unremovable [with ion exchange resin], and the charcoal filter 25 prepared in the preceding paragraph of ion-exchange type water treatment equipment 26 can also be omitted depending on the water quality of mixed water.

[Effect of the Invention] Invention according to claim 1 constituted the employment approach so that lowering of the electrical conductivity of ion exchange water and a break through of a silica might use generating almost simultaneous near the threshold value of the ion-exchange capacity of ion exchange resin as mentioned above, and the electrical conductivity of ion exchange water might be supervised by the last stage ion-exchange-resin cylinder entrance side, for example, two or more ion-exchange-resin cylinders of the preceding paragraph might be updated by making 1microS/cm into a decision value. Consequently, where the ion-exchange capacity of two or more ion-exchange-resin cylinders of the upstream is consumed without futility from the last stage ion-exchange-resin cylinder, while being able to update Since the silica and the conductive ion which were leaked are caught by the last stage ion-exchange-resin cylinder and can be supplied to the cooling water circulatory system of the body 1 of a fuel cell by using the ion exchange water of low electrical conductivity and low silica concentration as make up water The employment approach of the ion-exchange type water treatment equipment for fuel cells equipped with the function to prevent failures, such as power loss by the liquid junction of the body 1 of a fuel cell which became a problem with the conventional technique, and lock out of the passage by deposition of a silica, can be offered. Moreover, although lifting of silica concentration is directly supervised by time-consuming approaches, such as a colorimetric method, and it drops off, since it is detectable in sufficient precision practical by supervising lifting of electrical conductivity, the made advantage which can save labor the employment approach of ion-exchange type water treatment equipment is acquired. As mentioned above, while invention according to claim 2 changed the place of the last stage ion-exchange-resin cylinder of renewal of un-in the preceding paragraph from this, it was constituted so that relocation which arranges the updated ion-exchange-resin cylinder in the last stage might be performed. Consequently, the advantage which can consume the ion-exchange capacity of the last stage ion-exchange-resin cylinder of renewal of un-without futility is acquired.

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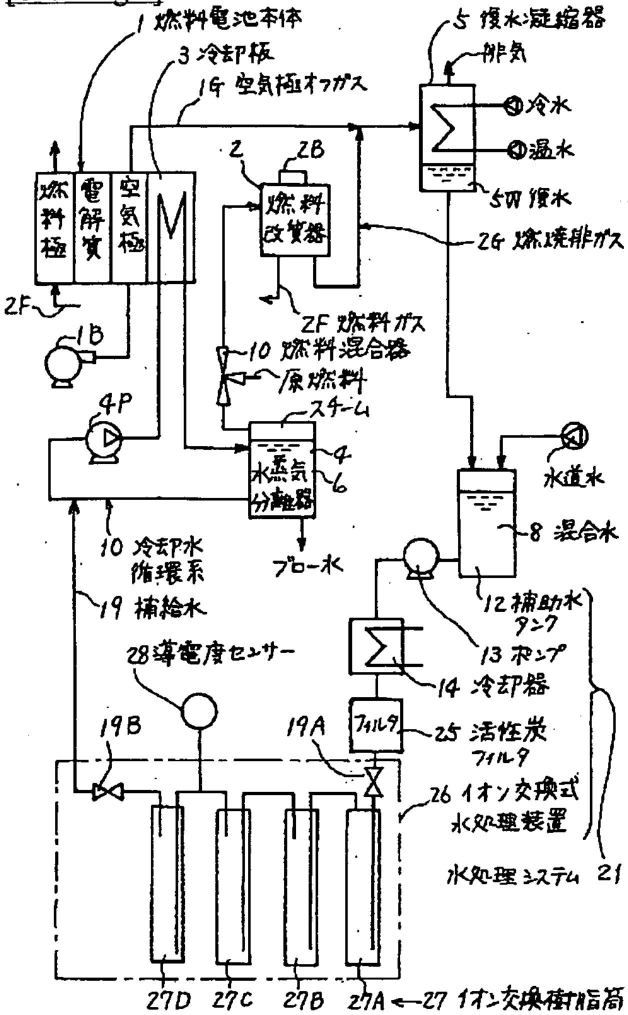
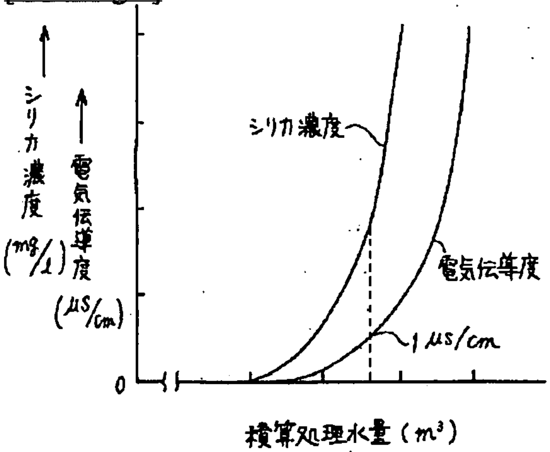
DRAWINGS

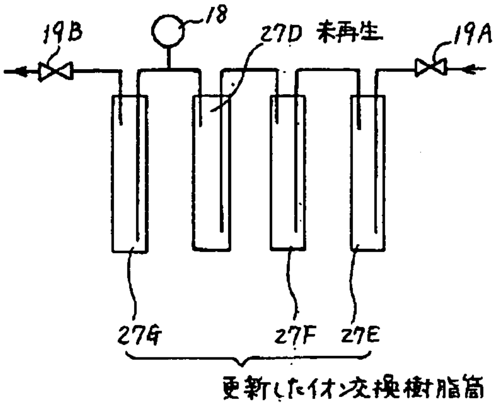
[Drawing 1]



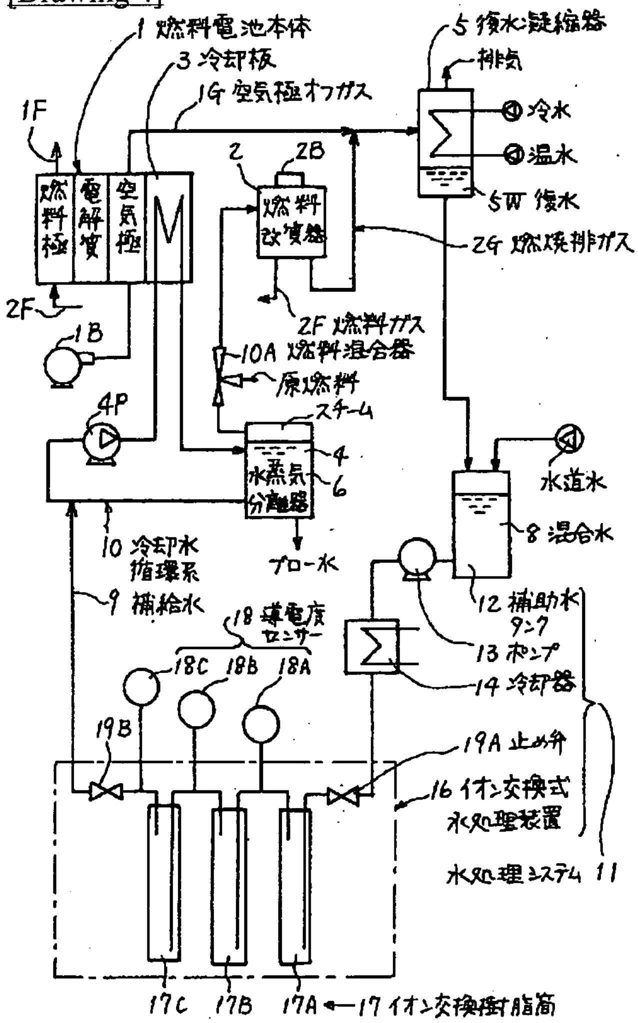
[Drawing 2]



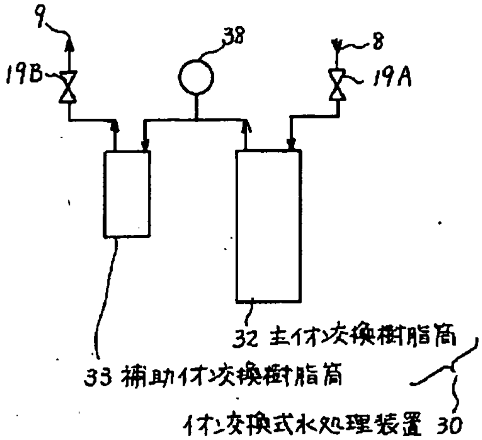
[Drawing 3]



[Drawing 4]



[Drawing 5]



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